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INTERNATIONAL SPACE STATION PAYLOAD SIMULATOR REQUIREMENTS DOCUMENT, VOLUME II FOR THE *PAYLOAD NAME (PAYLOAD ACRONYM)*

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INTERNATIONAL SPACE STATION
PAYLOAD SIMULATOR REQUIREMENTS DOCUMENT, VOLUME II
FOR *PAYLOAD NAME (PAYLOAD ACRONYM)*

D683-XXXX-2
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OCTOBER 8, 1996

Boeing Defense & Space Group
Missiles & Space Division
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ABSTRACT

This document presents the Payload Simulator Requirements Document (PSRD) Volume II for the *Payload Name* (*Payload Acronym*) simulator as agreed upon by the Marshall Space Flight Center (MSFC) Payload Training Integration Manager (PTIM) and the International Space Station (ISS) Payload Developer. The Volume II PSRD provides the information required to perform the Payload Simulator Inventory and Interface Checkout (PSIIC) for the *Payload Acronym* simulator that will be used in the Johnson Space Center (JSC) Space Station Training Facility Payload Training Capability (SSTF/PTC). This PSRD II defines appropriate simulator acceptance criteria and provides an inventory listing of simulator components as well as the installation and check out procedures necessary for a top level checkout of the *Payload Acronym* simulator. The Volume II PSRD also describes maintenance procedures and documents responsibility for various maintenance activities. This document was prepared by Teledyne Brown Engineering under the Payload Operations and Integration Function (POIF) contract NAS8-50000.

KEY WORDS

Class
Payload Training Capability (PTC)
Space Station Training Facility (SSTF)
Training Objective (TO)

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SECTION 1, INTRODUCTION

This document details the procedures for the installation, checkout, and maintenance of the *Payload Name (Payload Acronym)* simulator in the Space Station Training Facility/Payload Training Capability (SSTF/PTC). The procedures are either explicitly defined by the Simulation Engineer in the subsequent sections of this PSRD or provided by the User and included in the appendices of this document.

1.1 PURPOSE

The procedures included in this Volume II PSRD document will be performed during the PSIIC for the *Payload Acronym* simulator and shall be used to verify that the simulator was successfully shipped to the SSTF/PTC. The Volume II PSRD provides procedures which are used to inventory all simulator components, verify top-level interfaces, and check out the physical and electrical connections that are required of the *Payload Acronym* simulator. The PSRD Volume II will also provide directions for any repair and maintenance operations that may be required over the life of the *Payload Acronym* simulator and specify who will be responsible for the specific maintenance and repair procedures as negotiated by the Training Strategy Team (TST).

1.2 SCOPE

This PSRD is divided into six major sections and four appendices.

- Section 1, "Introduction", of this document states the general purpose of this document.
- Section 2, "Applicable Documents", lists all of the applicable documents which were referenced during the development of this PSRD and all of the documents that may be required during performance of the procedures presented in this PSRD.
- Section 3, "Simulator Components Inventory", provides a description of all of the simulator components associated with the *Payload Acronym* simulator that will be used in the SSTF/PTC. This section will be used to verify that all of the required simulator components specified in the PSRD Volume I are present.
- Section 4, "Installation Procedures", provides the installation procedures for the simulator hardware and software and specifies any support equipment or software required at the PTC in order to conduct the installation and verification process. Section 4 also contains a listing of the personnel required to support the simulator integration process along with the associated responsible organizations.

- Section 5, "Simulator Checkout Procedure" gives an overview of the systems to be checked out and provides operating procedures for the checkout of these systems.

- Section 6, "Maintenance Procedures", provides a description of the maintenance procedures for the portions of the *Payload Acronym* simulator that are to be serviced either on a routine basis or on the occurrence of an operational failure. This section also identifies the responsible organizations for the maintenance or repair operations. *If a Maintenance manual is provided by the User, this section may simply reference Appendix D which will contain the Maintenance manual.*

- Appendix A provides a list of the acronyms used in this document.

- Appendix B provides a list of the simulator classes and a brief description of the classification system.

- Appendix C contains a Simulator Users Guide provided by the User.

- Appendix D contains a User provided Maintenance manual.

SECTION 2, APPLICABLE DOCUMENTS

The following references may include documents, specifications, standards, guidelines, procedures, handbooks and other special publications. These documents, of the exact issue shown form a part of these requirements to the extent specified herein. Unless the exact issue and date are identified, the "Current Issue" cited in the contract Applicable Documents List (ADL) applies. Inclusion of applicable documents herein does not in any way supersede the contractual order of preference.

DOCUMENT NUMBER DATE/ISSUE	**TITLE**
A. Government Standards	
document # document date	*List all government standards documents that were used in preparing this document.*
B. Industry Standards	
document # document date	*List all industry standards documents that were used in preparing this document.*
C. NASA - MSFC Documents	
document # document date	*List any MSFC documents that were used in preparing this document.*
D. NASA - JSC Documents	
SST-427 *PUDG date*	Payload User Development Guide (PUDG) for the Space Station Training Facility/Payload Training Capability
document # document date	*List all other JSC documents that were used in preparing this document.*
E. Boeing Documents	
D683-43033 *ITP date*	All Flights Payload Integrated Training Plan
document # document date	*List all other Boeing documents that were used in preparing this document.*

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SECTION 3, SIMULATOR COMPONENTS INVENTORY

The initial stages of the hardware installation process will involve an inventory of all of the *Payload Acronym*-provided simulator components that should be present in the SSTF/PTC. Tables 3-I and 3-II provide a listing of all of the *Payload Acronym* hardware/software components provided by the user and the SSTF respectively. The following sections provide descriptions of each hardware item for the *Payload Acronym* simulator including specific cabling information.

TABLE 3-I *PAYLOAD ACRONYM* PROVIDED SIMULATOR COMPONENTS

SIMULATOR COMPONENT	QTY	CLASS	CL-DELIVERY DATE

TABLE 3-II SSTF/PTC-PROVIDED SIMULATOR COMPONENTS

SIMULATOR ELEMENT	QTY
US Lab Module	
PSSA	
Payload Executive Software	
Payload Acronym Payload Specific Data Files	
Payload Acronym Payload Application Software	

3.1 FIRST HARDWARE ITEM

This section should contain a full description of the first simulator hardware item listed in Table 3-I. The section can include figures, drawings, tables, or text to convey the hardware description.

3.2 SECOND HARDWARE ITEM

This section should contain a full description of the second simulator hardware item listed in Table 3-I. The section can include figures, drawings, tables, or text to convey the hardware description, etc.

SECTION 4, INSTALLATION PROCEDURES

Depending on the operational philosophy and capabilities of the SSTF/PTC, the installation process for any given simulator can occur in the US Lab or the Payload Simulator Staging Area (PSSA). This section will specify any support hardware or software required to conduct the installation and verification process and any personnel required to support the simulator installation process along with the associated responsible organizations. This section will provide the installation procedures for the hardware and software of the *Payload Acronym* simulator and will help to insure that the simulator is properly integrated into the SSTF/PTC. The organizations responsible for the simulator installation along with the personnel required to perform the inventory, installation, and checkout processes are listed in Table 4-I. *If a Simulator Users Guide containing installation instructions is provided by the User then this section may refer to Appendix C.*

TABLE 4-I *PAYLOAD ACRONYM* SIMULATOR INTEGRATION RESPONSIBILITY

INTEGRATION ACTIVITY	RESPONSIBLE ORGANIZATION	REQUIRED PERSONNEL
Rack Receiving	TSC	
Rack Moving	TSC	Crane Operator, ...
Rack Installation	TSC	
Payload Acronym Rack H/W Integration	PDC	PDC Training
Payload Specific S/W Installation and Check	PDC	PDC Training
etc.		

4.1. HARDWARE SUPPORT REQUIREMENTS

The following hardware components are required to support this activity: *Delete any that are not needed.*

1. PTC Host Computer System
2. Instructor/Operator Station (IOS)
3. International Space Station Module Simulator
4. Payload Simulator Staging Area
5. Overhead Crane
6. Forklift

7. Air bearing Pallet
8. PTC Audio System
9. PTC Video System
10. Power Requirements (specify!!!)
11. Suitcase Test Environment for Payloads (STEP)
12. ETC.

4.2. SOFTWARE SUPPORT REQUIREMENTS

The following software programs are required to support this activity: Delete any that are not needed.

1. Host System including Instructor/Operator Station (IOS)
2. Payload Executive Software (PES)
3. Payload Application Software (PAS)
4 Payload Specific Software (Preliminary Version of C&DH files)
5. Thermal Control System
6. Electrical Power System Simulator (EPS)
7. Environment Control and Life Support System Simulator (ECLSS)
8. ETC.

4.3 HARDWARE INSTALLATION

This section is intended to provide all of the information necessary to integrate the *Payload Acronym* simulator into the SSTF/PTC and verify experiment mounting locations, stowage locations, cable lengths and routing schemes, labeling and identification markings. *Each subsection below can contain figures and drawings as necessary to demonstrate proper hardware and stowage locations, and labeling.* Figure 4-1 shows the entire *Payload Acronym* layout with all of the appropriate hardware locations and front panel labels. *Specifics about the hardware to be installed can be pulled from the Section III inventory lists and divided below into Sections 4.3.1, 4.3.2 etc.*

4.3.1 Item One Installation

This section gives the specific information necessary to install hardware item number one for the Payload Acronym simulator hardware, etc.

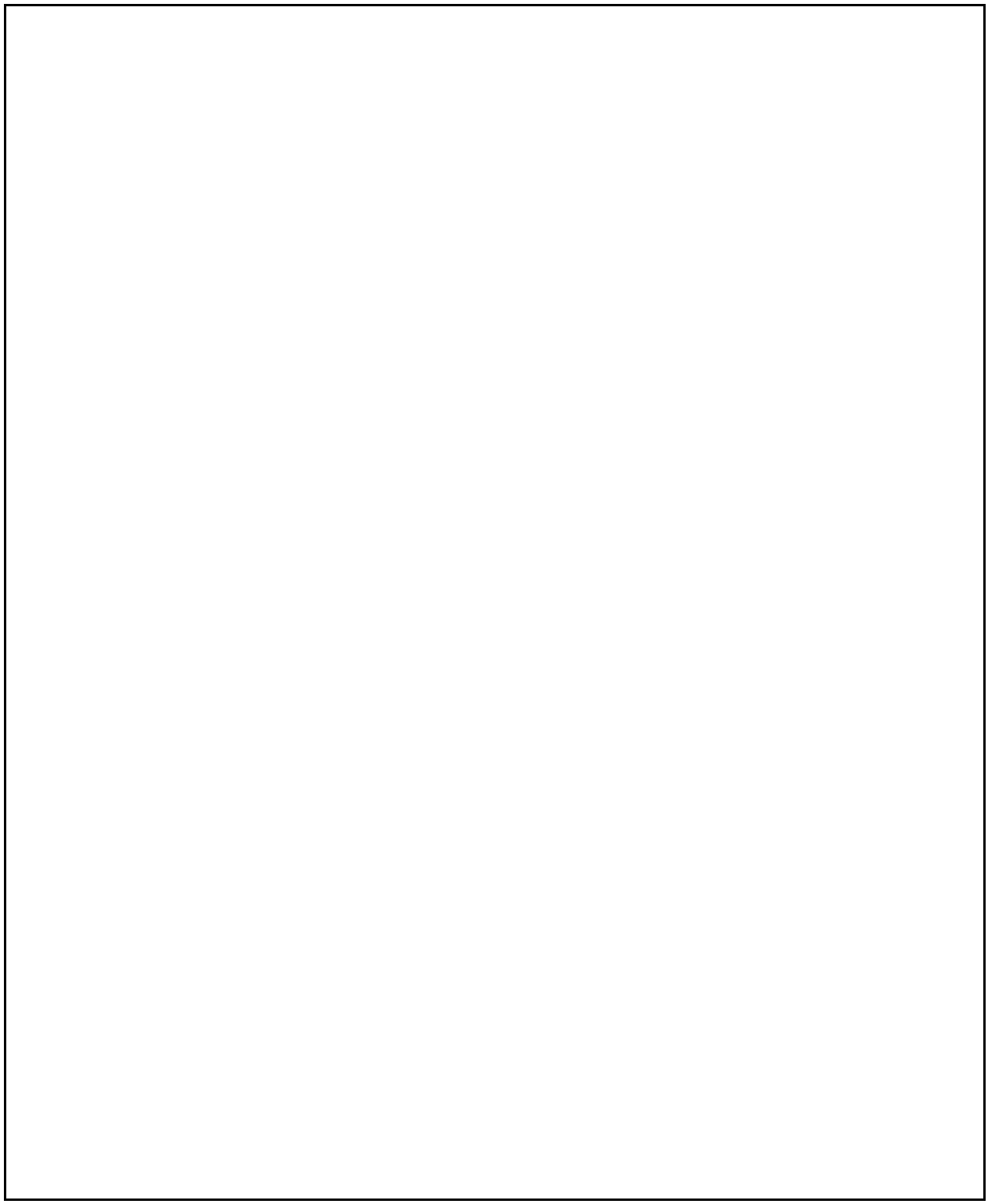

FIGURE 4-1 *PAYLOAD ACRONYM* LAYOUT

4.3.2 Cable Connections

All cable connections necessary for the *Payload Acronym* simulator will be specified in this section. The information given will include all of the following: fidelity level of the cable, cable types and lengths, connector types and labels for both ends of the cable, connector types and labels for the Payload connectors to which the cable will be attached, correct cable routing philosophy for cables connected to the front panel of the Payload, and any associated schematics or drawings. *The information can be arranged in a variety of ways (Figures, Tables, Text, Refer to an Appendix, etc.) and is up to the author's discretion. Table 4-II shows an example of a table with all relevant cable/connector information listed and Figure 4-2 shows the Payload Acronym cable routing scheme.*

TABLE 4-II EXAMPLE TABLE FOR CABLE IDENTIFICATION

CABLE LABEL	FIDELITY	TYPE	LENGTH	CONNECTOR TYPES/LABELS	ORIGIN	END POINT	FUNCTION

4.4 SOFTWARE INSTALLATION

The following subsections will give any necessary instructions on how to install and operate the *Payload Acronym* software. The software model will reside on the user-provided experiment processor (an *IBM 486, Silicon Graphics, Macintosh, Etc.)* and will provide a flight-like representation of the Payload Crew/User interfaces. *An explanation of what type of computer the User will provide (IBM, Macintosh, Silicon Graphics etc.) will be provided in this section. Specifics about the software installation and operation can be divided below into Sections 4.4.1, 4.4.2 etc.*

4.4.1 Software Activation/Initialization

This section gives specific information on how to install any payload software from a disk (if necessary), activate the payload software, set the simulator to a nominal state of operation, and control the software sufficiently to perform the checkout procedures presented in this document.

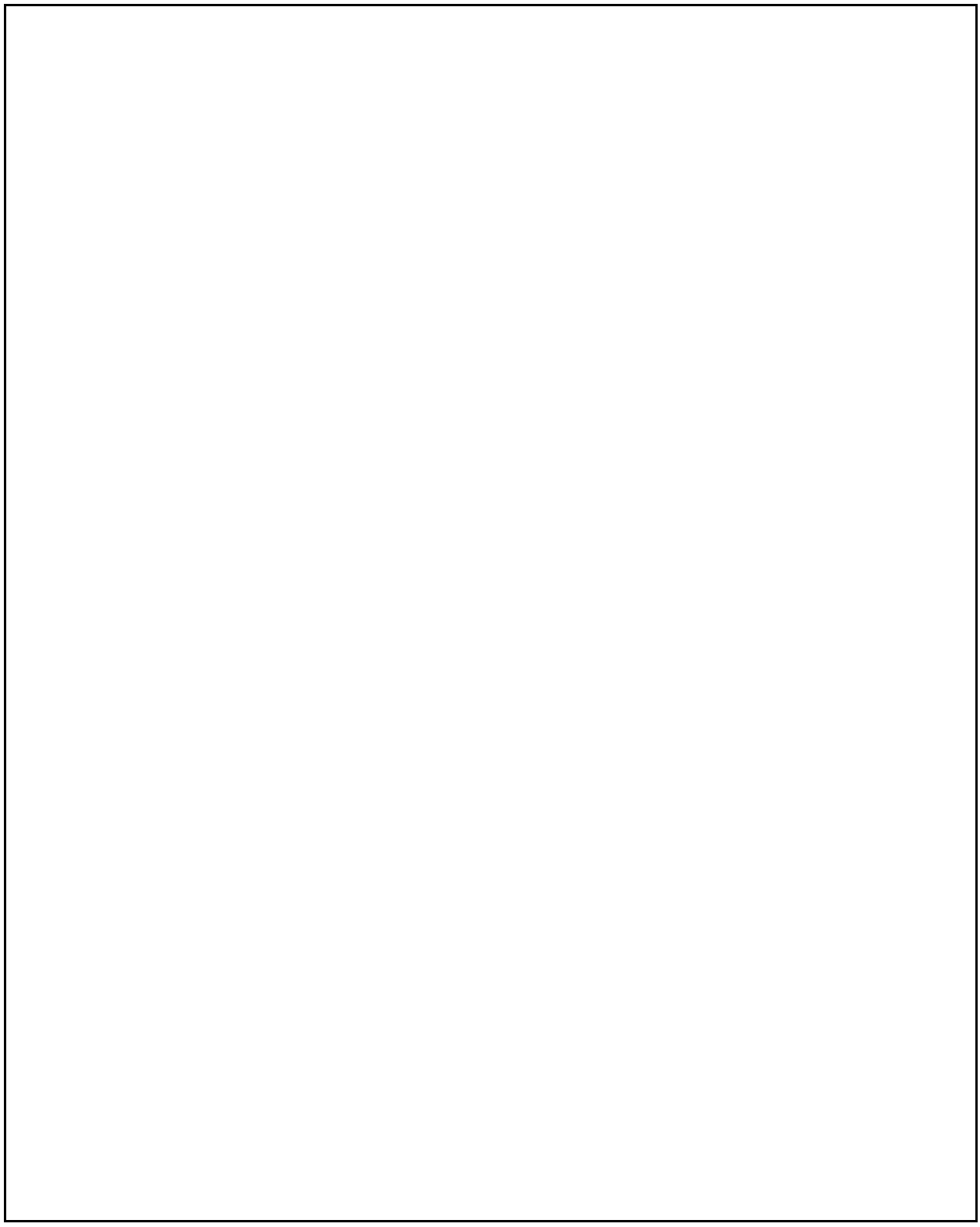

FIGURE 4-2 EXAMPLE FIGURE TO SHOW CABLE/CONNECTOR INFO

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SECTION 5, SIMULATOR CHECKOUT PROCEDURE

After the inventory of the *Payload Acronym* simulator hardware is complete, the next portion of the PSIIC process covering the simulator checkout can begin. This section provides the procedures for a top-level checkout of the *Payload Acronym* simulator. This checkout will insure that the Payload simulator is operating properly and is not producing unexpected outputs that could damage the SSTF/PTC systems. Any specific information on how to run the simulator for the checkout process will either be included in this section, or included as part of a Simulator Users Guide provided by the Payload Developer in appendix C. Depending on the operational philosophy and capabilities of the SSTF/PTC at the time of the PSIIC, the checkout process for any given simulator can occur in the US Lab, Payload Simulator Staging Area (PSSA), Rack Maintenance Area or stand-alone on the SSTF/PTC floor. If the checkout is to be done using the SSTF core systems models, then the simulator will reside in either the PSSA or US Lab and interface to the SSTF models. If the SSTF loading schedules do not allow enough time for simulator checkout, then the PSIIC for the payload simulator may occur stand-alone on the SSTF floor utilizing the SSTF/PTC Test Fixture and a Suitcase Test Environment for Payloads (STEP) to satisfy the core systems and Command and Data Handling (C&DH) interfaces.

5.1 MECHANICAL CHECKOUT

The objective of this test is to verify that the simulator is physically functional. The mechanical checkout will verify the correct operation of all of the mechanical components of the simulator. All switches, circuit breakers and other mechanical devices will be checked to insure that they are in the correct location and functioning properly. The tests will also verify that all stowage containers accommodate simulator stowage components, drawers and doors open/close smoothly and allow access to interior of components, and that all hardware elements that have no software interfaces are functioning properly. Table 5-I provides the specific step-by-step procedures to follow when performing the mechanical checkout of the *Payload Acronym* simulator. The subsections below describe the steps listed in Table 5-I and provide any information relevant for the safe and proper installation of that hardware item.

5.1.1 Step One

5.1.2 Step Two

5.2 POWER SYSTEMS TEST

A test will be performed to verify that the correct power is supplied to the *Payload Acronym* simulator. This includes the internal routing of power to each of the simulators powered components. Table 5-II provides the specific step-by-step procedures to follow when performing the power systems test for the *Payload Acronym* simulator. The subsections below discuss the specific requirements and expected responses for each step in Table 5-II.

5.2.1 Step One

5.2.2 Step Two

5.3 DATA FLOW CHECKOUT

A test will be performed to verify that the *Payload Acronym* simulator will safely start up, reach nominal operation, and begin to properly flow data. The test will verify that the simulator will at a minimum run in a nominal mode without lethal errors occurring that could damage the systems models. Table 5-III provides the specific step-by-step procedures to follow when performing the data flow checkout for the *Payload Acronym* simulator. The procedures to check each of the interfaces listed in Table 5-III are discussed in detail in the subsections below.

5.3.1 Ethernet

5.3.2 1553 Interface

5.3.3 PSimNet Interface

5.3.4 Video Interface

5.3.5 SCE Interfaces

TABLE 5-I PROCEDURE FOR MECHANICAL INTERFACES CHECKOUT

SIMULATOR ITEM	REQUIRED ACTION	EXPECTED RESPONSE	ACTUAL RESPONSE

TABLE 5-II PROCEDURE FOR POWER SYSTEMS CHECKOUT

SIMULATOR ITEM	REQUIRED ACTION	EXPECTED RESPONSE	ACTUAL RESPONSE

TABLE 5-III PROCEDURE FOR DATA FLOW CHECKOUT

SIMULATOR ITEM	REQUIRED ACTION	EXPECTED RESPONSE	ACTUAL RESPONSE
Ethernet			
1553 Interface			
PSimNet Interface			
Video Interface			
SCE Interface			

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SECTION 6, MAINTENANCE PROCEDURES

This section contains the detailed maintenance procedures for the *Payload Acronym* simulator. *If a Maintenance Manual has been provided by the User, document responsibility for maintenance operations as defined by the TST in this section and simply reference Appendix D for all actual maintenance procedures.* The following sections describe maintenance procedures for the portions of the *Payload Acronym* simulator that are to be either serviced on a routine basis or serviced upon the occurrence of an operational failure. Responsibility for specific maintenance and repair operations will be presented in this section as negotiated during the TST process.

6.1 ROUTINE MAINTENANCE

All activities that are considered routine maintenance for the *Payload Acronym* simulator (Replacement of bulbs, fuses, batteries, cleaning, etc.) will be defined in this section. The routine maintenance procedures for each part of the simulator are provided below.

6.1.1 Filter Replacement

This section, for example, will describe the replacement procedure for a filter for a payload simulator including the filter type, function, and location. It will also specify who will be responsible for the procedure and how often it might occur.

6.1.2 Overhead light Replacement

This section, for example, will describe the replacement procedure for an overhead light for a payload simulator including the bulb type and location. It will also specify who will be responsible for the procedure and how often it might occur.

6.2 FAILURE RECOVERY MAINTENANCE

The maintenance procedures to help recover from operational failures are defined in this section to include all operational failures not covered by Section 6.1. Specific detail on who is responsible for failure recovery maintenance will be discussed below.

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APPENDIX A

ABBREVIATIONS AND ACRONYM LIST

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A, ABBREVIATIONS AND ACRONYMS

ADL	Applicable Documents List
ECLSS	Environmental Control and Life Support System
ENV	Environmental Model (PTC)
EPS	Electrical Power System
HOSC	Huntsville Operations Support Center
ISPR	International Standard Payload Rack
IOS	Instructor Operator Station
ISS	International Space Station
JSC	Johnson Space Center
LNS	Lab Nitrogen System
MDM	Multiplexer/Demultiplexer
MSFC	Marshall Spaceflight Center
OBCS	Onboard Computer System
PAS	Payload Application Software
PCS	Portable Computer System
PEP	Payload Executive Processor
PES	Payload Executive Software
POIC	Payload Operations Integration Center
PSIIC	Payload Simulator Inventory and Interface Checkout
PSSA	Payload Simulator Staging Area
PSRD	Payload Simulator Requirements Document
PTC	Payload Training Capability
PUDG	Payload Users Development Guide
RAPS	Remote Area for Payload Support
SE	Simulation Engineer
SOC	Support Operations Contractor
SSTF	Space Station Training Facility
TO	Training Objective
TSC	Training Support Contractor
TST	Training Strategy Team
UDC	Utilization Development Capability
USOC	United States Operations Control

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APPENDIX B

SIMULATOR CLASS LEVELS

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B, SIMULATOR CLASS LEVELS

The five simulator class levels are defined as follows:

Class 1: Flight Equivalent Hardware. This is flight like hardware which may or may not be flight certified. Typical Class 1 simulators would be a duplicate of the flight hardware that was procured for training purposes, backup flight hardware, or an engineering model.

Class 2: Class 2 simulators have flight like hardware panels with fully functional controls and displays. Functionality for these panels is provided by a PD-provided software models which read panel switches, drive panel displays/indicators, and provide data to the crew and downlink displays. Class 2 simulators are further sub-divided into Class 2A and 2B. Class 2A run PD-supplied software on the SSTF Host computer system (note that this mode is not currently supported in the SSTF/PTC); Class 2B simulators run their software on a PD-provided simulation machine.

Class 3: Class 3 simulators are stand alone systems with virtual panels that are driven by a software load resident on the machine. Class 3 simulators are further sub-divided into Class 3A and 3B. Class 3A run PD-supplied software on the SSTF Host computer system (note that this mode is not currently supported in the SSTF/PTC); Class 3B simulators run their software on a PD-provided simulation machine.

Class 4: Class 4 simulators consist of front panels that have the physical look and feel of the flight unit, but no operable hardware or software behind the panel to add functionality.

Class 5: Class 5 simulators consist of front panels that are a photograph or are drawn to look like the flight panel. They have no operational switches/displays or functional software.

Table B-I provides the definition of the training component fidelity. While this can be applied to entire simulators it is usually applied to outfitting components of simulators (valves, knobs, switches, lights, etc.). For example, a payload simulator may have a requirement to be a class IIb simulator (hardware panels driven by a software model), while the hardware panels on that simulator may contain components that are of higher or lower fidelity than the overall designation of the simulator itself. The simulator may have a panel containing a door to a chamber which does not open. The chamber door is then classified as a III.C component. Due to the degree of crew interaction with a built in display/keypad on that same panel, a flight type keypad is used. Thus, the display/keypad is a I.A component.

TABLE B-I SIMULATOR COMPONENT FIDELITY

CLASS\FUNCTIONALITY	F. FLIGHT TYPE	A. FUNCTIONALLY ACTIVE	B. OPERABLE	C. STATIC
Flight Article	Flight equipment downgraded for training or not Certified	N/A	N/A	N/A
I.: Flight assembly tolerance Similar material Exact configuration	N/A	I.A	I.B	I.C
II.: Relaxed assembly tolerance Mixed material Approximate Configuration	N/A	II.A	II.B	II.C
III.: Approximate Dimensions Optional material Approximate configuration	N/A	III.A	III.B	III.C

The SSTF/PTC has the following interpretation of the categories listed above:

A: Replicates the active user interface of the analogous payload hardware, controls and displays, and interact with the system models. Controls operate in the same "sense" as the flight article.

B: Hardware without a Signal Conversion Equipment (SCE) interface. This applies generally to mechanical hardware without a systems interface.

C: Includes graphics or three dimensional objects added to aid in identifying or locating controls and displays.

I: Hardware matches flight article orientation, range of motion, display resolution, sound quality, color, texture and other relevant physical properties.

II: Hardware is three dimensional in an approximately correct relative orientation and are similar in appearance to the flight article. Size, exact color, and other physical properties not affecting the required functional fidelity may vary.

III: Hardware provides sufficient visual information to aid in locating controls and displays, without regard to flight article dimensions or materials. Controls and displays are packaged on flat panel assemblies and are capable of conveying the same information in the same general manner (lights-lights, dials-dials) as the flight article, but may vary in size, exact color, and other physical properties not affecting the required functional fidelity.

APPENDIX C

SIMULATOR USERS GUIDE

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Appendix C contains a Simulator Users Guide provided by the User.

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APPENDIX D

SIMULATOR MAINTENANCE MANUAL

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